



Questions from Medical Microbiology Book

1. A 20-year-old college student goes to the student health center because of dysuria, frequency, and urgency on urination for 24 hours. She has recently become sexually active. On urinalysis, many polymorphonuclear cells are seen. The most likely organism responsible for these symptoms and signs is
 - (A) *Staphylococcus aureus*
 - (B) *Streptococcus agalactiae*
 - (C) *Gardnerella vaginalis*
 - (D) *Lactobacillus* species
 - (E) *Escherichia coli*
2. A 27-year-old woman is admitted to the hospital because of fever, with increasing anorexia, headache, weakness, and altered mental status of 2 days' duration. She works for an airline as a cabin attendant, flying between the Indian subcontinent and other places in Southeast Asia and the West Coast of the United States. Ten days prior to admission she had a diarrheal illness that lasted for about 36 hours. She has been constipated for the last 3 days. Her temperature is 39 °C, heart rate 68/min, blood pressure 120/80 mm Hg, and respirations 18/min. She knows who she is and where she is but does not know the date. She is picking at the bedclothes. Rose spots are seen on the trunk. The remainder of the physical examination is normal. Blood cultures are done and an intravenous line is placed. The most likely cause of her illness is
 - (A) Enterotoxigenic *Escherichia coli* (ETEC)
 - (B) *Shigella sonnei*
 - (C) *Salmonella enterica* subspecies *enterica* serotype Typhimurium (*Salmonella* Typhimurium)
 - (D) *Salmonella enterica* subspecies *enterica* serotype Typhi (*Salmonella* Typhi)
 - (E) Enteroinvasive *Escherichia coli* (EIEC)

3. Blood cultures from the patient in Question 2 grow a non-lactose-fermenting gram-negative bacillus. Which of the following is likely to be a constituent of this organism?

- (A) O antigen 157, H antigen 7 (O157:H7)
- (B) Vi antigen (capsule; virulence antigen)
- (C) O antigen 139 (O139)
- (D) Urease
- (E) K1 (capsular type 1)

4. Four members of a migrant farmworker family— mother, father, and two young children— come to the emergency room because of diarrhea and fever of 6–12 hours' duration. Their stools have been frequent and flecked with blood. Several other people in the workers' camp have been ill with a similar diarrheal disease. This included the person who prepared the evening meal the previous day. The parents had normal physical examinations. The children showed signs of excessive fluid and electrolyte loss. The likely cause of this outbreak is

- (A) *Salmonella enterica* subspecies *enterica* serotype Typhimurium (*Salmonella* Typhimurium)
- (B) *Salmonella enterica* subspecies *enterica* serotype Typhi (*Salmonella* Typhi)
- (C) *Shigella flexneri*
- (D) Rotavirus
- (E) Enterotoxigenic *Escherichia coli* (ETEC)

7. A 60-year-old man was admitted to the hospital 2 weeks previously because of head trauma and other injuries that resulted from an automobile accident. A urinary tract catheter was inserted at admission and remains in place. The man develops a urinary tract infection with a gram-negative bacillus. The probable cause of this patient's infection is

- (A) *Pseudomonas aeruginosa*
- (B) *Providencia rettgeri*
- (C) *Escherichia coli*
- (D) *Morganella morganii*
- (E) Indeterminable without culture and identification Testing

8. An 18-year-old student has abdominal cramps and diarrhea. A plate of MacConkey's agar is inoculated and grows gram-negative rods. Triple sugar iron (TSI) agar is used to screen the isolates for salmonellae and shigellae. A result suggesting one of these two pathogens would be

- (A) Production of urease
- (B) Motility in the medium
- (C) Inability to ferment lactose and sucrose
- (D) Fermentation of glucose

(E) Production of gas in the medium

9. An uncommon serotype of *Salmonella enterica* subspecies *enterica* was found by laboratories in the health departments of adjacent states. The isolates were all from a small geographic area on either side of the border between the states, suggesting a common source for the isolates. (All the isolates were from otherwise healthy young adults who smoked marijuana; the same salmonella was isolated from a specimen of the marijuana.) By what method did the laboratories determine that these isolates were the same?

(A) Capsular (K antigen) typing

(B) O antigen and H antigen typing

(C) DNA sequencing

(D) Sugar fermentation pattern determination

(E) Decarboxylase reaction pattern determination

Answers

1. E

2. D 7. E

3. B 8. C

4. C 9. B

Streptococci

6. An 8-year-old boy develops a severe sore throat. On examination, a grayish-white exudate is seen on the tonsils and pharynx. The differential diagnosis includes group A streptococcal infection, Epstein-Barr virus (EBV) infection, severe adenovirus infection, and diphtheria. (*Neisseria gonorrhoeae* pharyngitis would be included also, but the patient has not been sexually abused.) The cause of the boy's pharyngitis is most likely

(A) A catalase-negative gram-positive coccus that grows in chains

(B) A single-stranded positive-sense RNA virus

(C) A catalase-positive gram-positive coccus that grows in clusters

(D) A catalase-negative gram-positive bacillus

(E) A double-stranded RNA virus

7. A primary mechanism responsible for the pathogenesis of the boy's disease (Question 6) is

(A) A net increase in intracellular cyclic adenosine monophosphate

(B) Action of M protein

- (C) Action of IgA1 protease
- (D) Action of enterotoxin A
- (E) Inactivation of elongation factor 2

8. A 40-year-old woman develops severe headache and fever. Her neurologic examination is normal. A brain scan shows a ring-enhancing lesion of the left hemisphere. At surgery, a brain abscess is found. Culture of the abscess fluid grows an anaerobic gram-negative bacillus (*Bacteroides fragilis*) and a catalase-negative gram-positive coccus that on Gram stain is in pairs and chains. The organism is beta hemolytic and forms very small colonies (< 0.5 mm in diameter). One person thought it smelled like butterscotch. It agglutinates with group F antisera. The organism most likely is

- (A) *Streptococcus pyogenes* (group A)
- (B) *Enterococcus faecalis* (group D)
- (C) *Streptococcus agalactiae* (group B)
- (D) *Streptococcus anginosus* group
- (E) *Staphylococcus aureus*

9. The single most important method for classifying and speciating streptococci is

- (A) Agglutination using antisera against the cell wall group-specific substance
- (B) Biochemical testing
- (C) Hemolytic properties (alpha, beta, nonhemolytic)
- (D) Capsular swelling (quellung) reaction
- (E) None of the above

10. An 8-year-old girl develops Sydenham's chorea ("St. Vitus' dance") with rapid uncoordinated facial tics and involuntary purposeless movements of her extremities, strongly suggestive of acute rheumatic fever. She has no other major manifestations of rheumatic fever (carditis, arthritis, subcutaneous nodules, skin rash). The patient's throat culture is negative for *Streptococcus pyogenes* (group A streptococci). However, she, her brother, and her mother all had sore throats 2 months ago. A test that if positive would indicate recent *Streptococcus pyogenes* infections is

- (A) Antistreptolysin S antibody titer
- (B) Polymerase chain reaction for antibodies against M protein
- (C) Antistreptolysin O antibody titer
- (D) Esculin hydrolysis
- (E) Antihyaluronic acid antibody titer

Answers

- 6. A
- 7. B
- 8. D
- 9. E

Staphylococci

1. A 54-year-old woman develops a right shoulder abscess with a strain of *Staphylococcus aureus* that is resistant to nafcillin. She was treated with a 2-week course of intravenous vancomycin and improved. Three weeks later (week 5), the infection recurred and she was given 2 more weeks of intravenous vancomycin and again improved. Four weeks later (week 11), the infection recurred and the patient was again started on intravenous vancomycin. The minimum inhibitory concentrations (MICs) for vancomycin for the *S aureus* isolates were as follows: initial isolate (day 1), 1 µg/mL; week 5, 2 µg/mL; and week 11, 8 µg/mL. The patient failed to improve with the third course of vancomycin, and alternative therapy was used. The mechanism that best explains the relative resistance of the patient's strain of *S aureus* to vancomycin is

- (A) Acquisition of the vanA gene from another microorganism
- (B) Active transport of vancomycin out of the *S aureus* cell
- (C) Action of beta-lactamase
- (D) Increased cell wall synthesis and alterations in the cell wall structure
- (E) Phosphorylation and resultant inactivation of the vancomycin

2. An 11-year-old boy develops a mild fever and pain in his upper arm. An x-ray film of his arm shows a lytic lesion (dissolution) in the upper part of the humerus with periosteal elevation over the lesion. The patient is taken to surgery, where the lesion is debrided (dead bone and pus removed). Culture from the lesion yields gram-positive cocci. A test shows that the organism is a staphylococcus and not a streptococcus. Based on this information, you know the organism is

- (A) Susceptible to nafcillin
- (B) Beta-lactamase-positive
- (C) A producer of protein A
- (D) Encapsulated
- (E) Catalase-positive

3. A 36-year-old male patient has an abscess with a strain of *Staphylococcus aureus* that is betalactamase- positive. This indicates that the organism is resistant to which of the following antibiotics?

- (A) Penicillin G, ampicillin, and piperacillin
- (B) Trimethoprim-sulfamethoxazole
- (C) Erythromycin, clarithromycin, and azithromycin
- (D) Vancomycin
- (E) Cefazolin and ceftriaxone

4. Seven days ago, a 27-year-old medical student returned from Central America, where she had spent the summer working in a clinic for indigenous people. Four days ago, she

developed an erythematous sunburn-like rash. She also has had headache, muscle aches, and abdominal cramps with diarrhea. Her blood pressure is 70/40 mm Hg. Pelvic examination shows she is having her menstrual period with a tampon in place; otherwise, the pelvic examination is normal. Her kidney function tests (serum urea nitrogen and creatinine) are abnormal, indicating mild renal failure. A blood smear for malaria is negative. Her illness is likely to be caused by which of the following?

- (A) A toxin that results in greatly increased levels of intracellular cyclic adenosine monophosphate (cAMP)
- (B) A toxin that degrades sphingomyelin
- (C) A toxin that binds to the class II major histocompatibility complex (MHC) of an antigen presenting cell and the V β region of a T cell
- (D) A two-component toxin that forms pores in white blood cells and increases cation permeability
- (E) A toxin that blocks elongation factor 2 (EF2)

5. Over a period of 3 weeks, a total of five newborns in the hospital nursery developed *Staphylococcus aureus* infections with *S aureus* bacteremia. The isolates all had the same colony morphology and hemolytic properties and identical antimicrobial susceptibility patterns, suggesting that they were the same. (Later molecular methods showed the isolates were identical.) Which of the following should be done now?

- (A) Prophylactic treatment of all newborns with intravenous vancomycin
- (B) Protective isolation of all newborns
- (C) Closing the nursery and referring pregnant women to another hospital
- (D) Hiring all new staff for the hospital nursery
- (E) Culture using mannitol salt agar of the anterior nares of the physicians, nurses, and others who cared for the infected babies

6. The exfoliative toxins, toxic shock toxin 1 (TSST- 1), and the enterotoxins are all superantigens. The genes for these toxins are

- (A) Present in all strains of *Staphylococcus aureus*
- (B) Widely distributed on the staphylococcal chromosome
- (C) On both the staphylococcal chromosome (TSST-1 and exfoliative toxins) and on plasmids (enterotoxins)
- (D) On the staphylococcal chromosome in a pathogenicity island
- (E) On plasmids

7. A 16-year-old bone marrow transplant patient has a central venous line that has been in place for 2 weeks. He also has a urinary tract catheter, which has been in place for 2 weeks as well. He develops fever while his white blood cell count is very low and before the transplant has engrafted. Three blood cultures are done, and all grow *Staphylococcus epidermidis*. Which one of the following statements is correct?

- (A) The *Staphylococcus epidermidis* organisms are likely to be susceptible to penicillin G.

- (B) The *Staphylococcus epidermidis* organisms are likely to be from the surface of the urinary tract catheter.
- (C) The *Staphylococcus epidermidis* organisms are likely to be resistant to vancomycin.
- (D) The *Staphylococcus epidermidis* organisms are likely to be from a skin source.
- (E) The *Staphylococcus epidermidis* organisms are likely to be in a biofilm on the central venous catheter surface.

8. A 65-year-old man develops an abscess on the back of his neck. Culture yields *Staphylococcus aureus*. The isolate is tested and found to be positive for the *mecA* gene, which means that

- (A) The isolate is susceptible to vancomycin
- (B) The isolate is resistant to vancomycin
- (C) The isolate is susceptible to nafcillin
- (D) The isolate is resistant to nafcillin
- (E) The isolate is susceptible to penicillin G
- (F) The isolate is resistant to penicillin G

9. Antimicrobial resistance has become a significant problem. Which one of the following is of major concern worldwide?

- (A) Nafcillin resistance in *Staphylococcus aureus*
- (B) Penicillin resistance in *Streptococcus pneumoniae*
- (C) Penicillin resistance in *Neisseria gonorrhoeae*
- (D) Vancomycin resistance in *Staphylococcus aureus*
- (E) Tobramycin resistance in *Escherichia coli*

10. A group of six children under 8 years of age live in a semitropical country. Each of the children has several crusted weeping skin lesions of impetigo (pyoderma). The lesions are predominantly on the arms and faces. Which of the following microorganisms is a likely cause of the lesions?

- (A) *Escherichia coli*
- (B) *Chlamydia trachomatis*
- (C) *Staphylococcus aureus*
- (D) *Streptococcus pneumoniae*
- (E) *Bacillus anthracis*

Answers

1. D 6. D
2. E 7. E
3. A 8. D
4. C 9. D
5. E 10. C

Neisseriae

1. The inhabitants of a group of small villages in rural sub-Saharan Africa suffered an epidemic of meningitis. Ten percent of the people died, most of them under the age of 15 years. The microorganism that most likely caused this epidemic was

- (A) *Streptococcus agalactiae* (group B)
- (B) *Escherichia coli* K1 (capsular type 1)
- (C) *Haemophilus influenzae* serotype b
- (D) *Neisseria meningitidis* serogroup A
- (E) West Nile virus

2. A 19-year-old man presented to the clinic with a urethral discharge for the past 24 hours. *Neisseria gonorrhoeae* was cultured from the specimen and found to be beta-lactamasepositive and resistant to high levels ($\geq 32 \mu\text{g/mL}$) of tetracycline. Which of the following statements about these antimicrobial resistance factors is correct?

- (A) Beta-lactamase production and high-level resistance to tetracycline are both mediated by genes on plasmids
- (B) Beta-lactamase production is mediated by a gene on the bacterial chromosome while high-level tetracycline resistance is mediated by a gene on a plasmid
- (C) Beta-lactamase production is mediated by a gene on a plasmid while high-level tetracycline resistance is mediated by a gene on the bacterial chromosome
- (D) Beta-lactamase production and high-level resistance to tetracycline are both mediated by genes on the bacterial chromosome

3. Modified Thayer-Martin medium was developed to increase the recovery of *Neisseria gonorrhoeae* from genital tract specimens. This medium can also be used for throat cultures for neisseriae. The ingredients that make this medium selective for neisseriae are

- (A) Agar
- (B) A source of amino acids
- (C) Antibiotics
- (D) Glucose
- (E) Vitamins

4. A 6-year-old boy develops fever and headache. He is taken to the emergency room where he is noted to have a stiff neck, suggesting meningeal irritation. A lumbar puncture is done and culture of the cerebrospinal fluid grows *Neisseria meningitidis* serogroup B. Which of the following should be considered for his family (household) members?

- (A) No prophylaxis or other steps are necessary
- (B) They should be given *Neisseria meningitidis* pilin vaccine

(C) They should be given *Neisseria meningitidis* serogroup B polysaccharide capsule vaccine

(D) They should be given rifampin prophylaxis

(E) They should be given sulfonamide prophylaxis

5. An 18-year-old woman who reports unprotected sex with a new partner 2 weeks previously develops fever and left lower quadrant abdominal pain with onset in association with her menstrual period. On pelvic examination in the emergency room there is bilateral tenderness when the uterus is palpated. A mass 2–3 cm in diameter is felt on the left, suggestive of tubo-ovarian abscess. Subsequently, *Neisseria gonorrhoeae* is cultured from her endocervix. The diagnosis is gonococcal pelvic inflammatory disease. A common sequela of this infection is

(A) Cancer of the cervix

(B) Urethral stricture

(C) Uterine fibroid tumors

(D) Infertility

(E) Vaginal-rectal fistula

6. A 38-year-old vice squad police officer comes to the emergency room with a chief complaint expressed as follows: "I have disseminated gonococcal infection again." He is correct. Cultures of his urethra and knee fluid yield *Neisseria gonorrhoeae*. He has previously had five episodes of disseminated gonococcal infection. The patient should be evaluated for

(A) Selective IgA deficiency

(B) A polymorphonuclear cell chemotactic defect

(C) Deficiency of a late-acting complement component C5, C6, C7, or C8

(D) Absent lymphocyte adenosine deaminase activity

(E) Myeloperoxidase deficiency

Answers

1. D 4. D

2. A 5. D

3. C 6. C

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